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U.S. Environmental Protection Agency, Region 5 Field Quality Procedures

TECHNICAL FIELD STANDARD OPERATING PROCEDURE

STANDARD OPERATING PROCEDURE FOR THE OPERATION OF THE XACT 625 SEMI-CONTINUOUS METALS MONITORING TRAILER

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REVISION/CHANGE HISTORY

The table below identifies changes to this controlled document and the respective effective date(s) over time.

Revision Number	History/Change Description	Document Author/Owner	Management Approver	Effective Date
0	Original Document	Scott Hamilton	Loretta Lehrman	2/19/2014
1	Annual Review. Put document into standard Field Operations Group format. Added and updated validation table, blank test procedure, XRF calibration check procedure, added updated site check sheets and other field sheets. Updated data validation process. Added data record form.	Scott Hamilton	Loretta Lehrman	5/27/2014
2	Xact trailer has not been in operation by EPA since 2015. Reformatted and reordered operations section. Updated reviewers and manager. Update and review MQO and data validation tables according to most recent Xact 625 manual. Added new references and action limits to MQO table. Update data storage to SharePoint.	Scott Hamilton	Michael Compber	12/12/2018

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1.0 PURPOSE

- 1.1 This Standard Operating Procedure (SOP) describes procedures to be used when operating the Cooper Environmental Services (CES) Xact 625 Semi Continuous Metals Monitor.

2.0 APPLICABILITY/SCOPE

- 2.1 This document applies to the operation of the Xact 625 semi-continuous metals monitoring trailer and must be followed in conjunction with the instrument manual. In instances where deviations are found between the instrument manual and this Standard Operating Procedure (SOP), CES will be consulted and the SOP will be amended, reviewed and approved as soon as is practical. A deviation memo may also serve as documentation.
- 2.2 This SOP must be available to all operators. A copy of this SOP must be placed inside the trailer.
- 2.3 Users should make hand written notes in the SOP where improvements can be made for the next revision.
- 2.4 The official signed copy of this SOP will be stored in the Xact folder on the Air Monitoring and Analysis (AMAS) SharePoint site. This SOP should be reviewed annually.
- 2.5 This document covers the following procedures: Trailer and Monitoring System Start Up/Shut Down, Flow Checks/Calibrations, Temperature Checks/Calibration, Barometric Pressure Checks/Calibration, Leak Checks, Tape Change, Data Transfer, XRF checks, QA Energy Calibration, QA Blank procedure and the Data Validation procedure.
- 2.6 This SOP is not meant to replace the instrument manual but is a more detailed and procedurally oriented guide to the Region 5 field operation of the monitoring system. A compilation of all instrument manuals and all trailer components is located inside the trailer.
- 2.7 This SOP is written as a supplement to the instrument manual and the Quality Assurance Project Plan. The analyzer's operation manual should be read before any calibration, audit, or maintenance is performed. The instrument manual and this SOP must be available at the monitoring station as a reference guide.

3.0 DEFINITIONS (Omitted)

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4.0 SUMMARY OF METHOD/PROCEDURE

- 4.1 The Xact 625 semi-continuous metals monitor is housed in an 18 foot environmentally controlled trailer. The trailer has a diesel generator as well as an automatic power distribution system for power interruptions (not currently in use). The trailer also has a sampling platform on the roof. The shoreline power requirement uses a "Hubble" Pin/Sleeve Receptacle (Number of Poles 3, Number of Wires 4, Phase Single, Voltage Rating 125/250 Volts, and Current Rating 100 Amps). The Xact 625 is controlled by an onboard computer system. (For reference only the Grainger Part Number for a suitable receptacle and back box is Hubble Receptacle 3P, 4W P/N 6C557 and Receptacle Back Box P/N 4CT36).
- 4.2 An air sample is drawn into the inlet by a vacuum pump inside the trailer. The sample inlet is a standard PM10 (or TSP) sampling inlet (described in 40 CFR Part 50). An automated reel to reel filter tape system is used to move the sampling tape into one of two positions. In the first position a sampling nozzle is raised to the sampling inlet down tube allowing sample to deposit on the tape. At the second location analysis of the sample occurs. After a user defined sampling interval the tape advances, placing the collected sample spot in the X-ray excitation and analysis section of the instrument and initiating sampling onto a previously unexposed spot on the tape. The sequence of sampling and analysis continues automatically. The duration of sample collection at each spot can be manually varied to maintain detection performance in the face of varying atmospheric PM10 (or TSP) levels.
- 4.3 The Xact 625 employs energy-dispersive X-ray fluorescence (EDXRF), in which the detector and electronics resolve emitted X-rays based on their energy. The EDXRF approach allows use of a relatively simple optical path and a relatively low power X-ray source. The EDXRF approach also provides acquisition of the entire X-ray spectrum very rapidly, so that many elements in the periodic table can be detected within a few seconds. The Xact 625 samples ambient air at a constant flow rate of 16.7 L/min. The Xact 625's sample inlet is designed to provide uniform sample deposition and the instrument analyzes approximately 90% of the sample spot area. In addition to the general features of ambient metals monitors outlined above, the Xact 625 employs automatic internal stability to track the monitor's performance.
- 4.4 The monitoring method does not involve physical collection of samples. Rather a sample is collected on a Teflon tape reel and then analyzed immediately after sampling has occurred.

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5.0 PERSONNEL QUALIFICATION/RESPONSIBILITIES

- 5.1 Personnel working on this monitoring system must meet minimum training requirements for safety and technical expertise. Minimum technical training shall include at least 2 years of prior experience in the field of ambient air monitoring and on site hands on training with the Xact monitoring project Field Manager.

6.0 EQUIPMENT AND SUPPLIES

- 6.1 The following must be at the monitoring station to conduct checks, maintenance, data download or repairs. A more extensive list will be needed for major repairs.
1. Certified flow, temperature and barometric pressure standards (i.e. Delta Cal)
 2. Inlet adapter with shutoff valve
 3. Appropriate reporting sheets or tables, pen and calculator
 4. A complete set of tools for making mechanical and electrical connections and repairs
 5. A cellular telephone
 6. Upscale metals reference standards
 7. Water, canned air and Rubbing Alcohol.
 8. Q-Tips and Kim-Wipes
 9. Tape roles

7.0 REAGENTS AND STANDARDS

- 7.1 All flow, temperature and pressure calibration standards are to be independent of audit standards and certified according to the following chart. Certification must be conducted against a qualified NIST traceable device(s) of adequate authority.

Table 1: List of Standards and Certification Frequency

Standard	Certification Frequency	Acceptable Range
Flow	Annually	±2.0% of NIST Traceable Standard
Temperature	Annually	±0.1 C resolution ±0.5 C accuracy
Barometric Pressure	Annually	±1 mm Hg resolution ±0.5 mm Hg accuracy
XRF metals standards	None	*SEE NOTE BELOW
Time (Clock)	Use www.time.gov for the most accurate time.	

* THE FOLLOWING INFORMATION IS FROM CES (updated 11/7/2018) ABOUT XRF METALS STANDARDS CERTIFICATION PERIODS AND TRACABILITY OF METALS MEASUREMENTS. *Metals standards were obtained from Micromatter Co., Vancouver, BC and subsequently verified by CES. The CES laboratory instrument is calibrated using large 47mm Micromatter standards as mentioned in I.O 3.3 Section 11.2. This calibration is checked*

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using sensitivity curves generated from these certified gravimetrically vapor deposited standards. Once the unit is calibrated, NIST standard reference material (SRM) 1832 (SN 1228) and SRM 1833 (SN 987) are run as unknown samples and the concentration for each metal are checked against the published concentrations. (See Appendix G for SRM certificates of traceability). The SRMs are again run once every 30 days to ensure the instrument's calibration is still accurate.

The Xact 625 instrument and sensitivity curves are created from the specific set of 25mm standards (SN 32860-32892). See Appendix G for the Metals standards analysis report. The standard set was run side by side on the CES laboratory instrument with the CES 25mm standards (SN 17256-17295) and the concentrations were compared. Both 25mm standard sets are gravimetrically certified through physical vapor disposition by Micromatter Co. However, due to the physical form difference between the 25mm standards and the NIST SRMs the 25mm standards are not directly linked to the SRMs because the NIST checked sensitivity curves are not relevant. Because the standards are gravimetrically traceable through the process they are manufactured and the ability to check the standards through sensitivity curve that direct traceability of the SRMs to the Xact 625 standards isn't needed.

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8.0 HEALTH AND SAFETY CONSIDERATIONS

- 8.1 All operators must complete the minimum safety training as required by the USEPA. Minimum safety training shall include the USEPA 24 hour field safety course and annual 8 hour refresher courses as required.
- 8.2 Please refer to the Xact Manual 625-00010-00 REVP4 Section 2 for specific hazards present when operating this instrument.
- 8.3 **IF OPERATOR IS OPENING FRONT DOOR OF THE SAMPLING AND ANALYSIS MODULE** you must wait for X-ray voltage and current to ramp down and red light to turn off on the XRF module. After the light is off the operator may then remove the X-ray key and unlock the door using the door key. **THE DOOR CANNOT BE OPENED IF THE X-RAY IS ENERGIZED AND THE RED LIGHT IS ON. NEVER DEFEAT OR OTHERWISE MANUPULATE THE SAFETY MECHANISM ON THE XRF DOOR.** As an additional safety measure the entire cabinet including the door is interlocked and once any door or access panel is opened the X-rays immediately shut off.
- 8.4 The Xact monitoring trailer runs on 230 VAC. Electrocutation can occur if operators do not take necessary precautions. Be aware of all energized sources of electricity. Always de-energize all equipment when performing maintenance or repairs. (See Appendix D for trailer drawings and electrical schematics)
- 8.5 Never attempt to connect, disconnect, repair or troubleshoot the main power of the trailer. This must be done by a licensed certified electrician.
- 8.6 In case of fire get out fast and call 911.
- 8.7 The trailer has a climbing ladder permanently attached to the road side to accommodate usage of the sampling platform. Always inspect the ladder before each use to ensure it is in serviceable condition. Face ladder when climbing up or down; keep body centered between rails. Maintain a firm grip. Use both hands in climbing.
- 8.8 The trailer is equipped with a diesel generator which produces carbon monoxide while running. Carbon monoxide is a colorless, odorless, and tasteless gas that is slightly lighter than air. It is toxic to humans and animals when encountered in higher concentrations and can cause death if inhaled. The trailer is equipped with a CO detector. If the detector sounds evacuate the trailer immediately leaving the door open until the detector stops. Always vent the generator exhaust downwind of the trailer.

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9.0 INTERFERENCES

- 9.1 All tasks for the monitoring project must be scheduled and completed deliberately with a specific purpose such as meeting a measurement quality objective (MQO) or because the Xact Manual states that the task is to be completed. Under no circumstances are changes to the monitoring system to be made without first consulting with the project manager and/or CES experts.
- 9.2 The Xact monitoring trailer is to be kept clean and free of clutter at all times.
- 9.3 Never close windows on the main trailer computer. This computer runs the Xact monitoring system. Abrupt shut down of the system components will cause severe damage.
- 9.4 Never activate the Xact Terminal program within 15 minutes of the conclusion of a sampling period. This could result in instrument malfunction and data loss.
- 9.5 Always check the conditions of all lines and fittings. Be certain that they are clean and the fittings are tight. Always make visual checks of the system as a whole. Any observations shall be documented in the logbook and noted for follow up.

10.0 PROCEDURES

10.1 Trailer Start Up Procedure

- 1. The Xact monitoring trailer should be placed in a position that meets all requirements of 40 CFR 58 Appendix E (or as close to regulatory requirements as possible), Probe and Monitoring Path Siting Criteria for Ambient Air Monitoring and the Quality Assurance Handbook for Air Pollution Measurement Systems Volume II, Section 6, Monitoring Network Design.
- 2. After the trailer is positioned place chokes behind and in front of the wheels, unlock and open coupler, disconnect safety chains, trailer lighting harness, safety brake mechanism, and open coupler. Raise trailer jack and pull tow vehicle forward.
- 3. Install the four corner jacks and place plywood under the feet. Raise trailer up slightly so that the some of the trailers' weight is off the wheels. Level the trailer.
- 4. Install the exhaust extension on the diesel generator exhaust (if needed). Determine the prevailing wind direction and run the exhaust downwind from the trailer.
- 5. Install the shore power electrical cord to the proper receptacle or otherwise connect shore power. Be certain that the cord is not a trip hazard and that the cord will not be run over by vehicles or other equipment. If necessary, use qualifiers or markers.
- 6. Install safety railing on sampling deck.
- 7. Power up the trailer in the following order: turn on main trailer power, turn on UPS, turn on main power in the rear of the Xact modules, turn on ESC data logger, turn on

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computer (PASSWORD = ces), start program “XactPwr” and turn power on, minimize “XactPwr”, Start program “XRF_Control” and wait until the XRF Control program fully initializes all XRF equipment. Ensure that a clean tape is installed. Push OPERATE on the main screen of the Xact and put Xact in RUN mode. It is recommended that the Xact is run overnight to allow the system to stabilize prior to conducting any calibrations or checks.

8. After the system has warmed and stabilized sufficiently the following checks must be completed: Flow Control System Leak Test (Perform anytime a connection break occurs in the flow system), Temperature and Pressure Sensor Calibration Test, Flow Calibration, Flow Calibration Test, QA Energy Calibration (perform before an XRF calibration), XRF Calibration Test, QA Upscale Test, Manual QA Blank Test, XRF Calibration (as needed or if XRF Calibration Test results require a full calibration), Examine tubing, enclosure, and components for particle build-up, rust or damage. Replace parts as needed.
9. After all calibrations and checks are completed the operator should verify that 1 sample data point is produced prior to leaving the site (i.e. a full cycle of sampling and analysis).

10.2 Trailer Shut Down Procedure

1. Push operate on the main screen of the Xact and change the mode to OFF.
2. After XRF_Control voltage and current status boxes turn blue it is safe to exit XRF_Control.
3. Use the XactPwr window on the computer to turn power off.
4. Shut down computer.
5. Shut down Xact modules and all other components.
6. Remove deck railing, exhaust extension, choke wheels and lower trailer, remove jacks, place tow vehicle ball directly below coupler and lower trailer onto ball, lock coupler and install safety chains, trailer lighting harness and safety brake mechanism and remove chokes.

10.3 Xact 625 Operations. The follow table is a suggested schedule of activities according to the Xact 625 operations manual (625-00010-00 REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015). Each activity is described in Section 10 in the order presented in the Table. Additionally, see the MQO Table in section 10 for a listing of action limits and acceptance criteria.

Table 2: Xact 625 Operations Schedule

Preventative Maintenance	Following Installation	Nightly	Monthly	3 Months	Annually
XRF Calibration (ONLY as needed or if XRF Calibration Test results require a full calibration)					

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QA Energy Calibration (perform before an XRF calibration)	X	X			
QA Upscale Test (internal upscale rod and Pd)		X (Pd is hourly)			
Manual QA Blank Test	X		X		
XRF Calibration Test (independent thin film standards)	X			X	
Leak Test	X		X		
Temperature and Pressure Sensor Calibration Test	X		X		
Flow Calibration Test	X		X		
Flow Calibration	X			X	
Examine tubing, enclosure, and components for particle build-up, rust or damage. Replace and clean parts as needed.	X		X		
Complete Site Check Sheet	X		X		
Update the QA Tracking spreadsheets for nightly checks and blanks as needed.			X		

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- 10.3.1 Full XRF Calibration Procedure – The full procedure is found in Section 5.10.3 of REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015. **GENERAL USERS OF THIS SOP SHOULD NOT RUN THE FULL XRF CALIBRATION. CONTACT COOPER ENVIRONMENTAL AND THE XACT 625 FIELD LEAD IF THIS PROCEDURE IS REQUIRED.**

- 10.3.2 QA Energy Calibration – The full procedure is found in Section 5.4 of REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015.

This test is run as an automated nightly test and should also be run prior to conducted upscale tests. Additionally, if the unit has not completed a QA Energy calibration in the last 24 hours, a manual QA Energy calibration should be completed before starting a sampling and analysis cycle. All QA Energy data is written to C:\Program Files\Xact 625\Data_Files. It is suggested to track the Peak Max Value (should not change by over 7,000 counts per day) and the number of rough and fine retries (should not exceed 1-2 per day).

- 10.3.3 QA Upscale Test (internal upscale rod and Pd) – The full procedure is found in Section 5.5 of REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015.

The QA upscale test encompasses two tests. One test is conducted each hour using the Pd rod installed in the XRF chamber. The second test detects chromium (Cr), lead (Pb), and cadmium (Cd) from a rod attached to the linear actuator. This test is run as an automated nightly test. Additionally, a manual QA Upscale test should be performed after the initial installation and anytime a full XRF calibration has been performed. After a calibration or a start up the user should average the first 5 daily metals values to arrive at the expected concentration. These values should be input into the Xact 625 controller under SETUP/QA Pd and QA UPSCALE. The QA Upscale Test (internal upscale rod and Pd) should not vary by more than 10% from the expected value.

- 10.3.4 Manual QA Blank Test – The full procedure is found in Section 5.3 of REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015. The procedure in the current manual must be followed precisely. The QA blank test is conducted by advancing the tape to a clean spot. The operator then disables the automation mode XRF Control and runs a one-hour acquisition. The blank test data will be written to the folder c:\Process Data on the Xact computer. The data should also be copied to a tracking spreadsheet and stored on the Xact SharePoint site under the project folder.

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- 10.3.5 XRF Calibration Test (independent thin film standards) – The full procedure is found in Section 5.10.1 of REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015. **This test will only be completed by specially trained staff. Training must consist of onsite field training by the Xact 625 field lead.** The procedure in the current manual must be followed precisely.

The general project specific procedure follows.

1. Conduct Blank Test.
 2. Conduct a manual QA Energy calibration.
 3. Evaluate results of blank test and QA Energy test to ensure they are acceptable to continue.
 4. Conduct analysis of the thin film metals standards at all 3 energy conditions (currently using metals standards K SN 32860, Cr SN 32864, As SN 32873, Cd SN 32882 Pb SN 32891).
 5. Document all results in the logbook.
 6. Compare the results of the acquired metals data versus metals standard values. The average percent difference of all metals standards should not exceed 10%.
 7. Include these data in a tracking spreadsheet.
 8. Save the data files produced to the Xact SharePoint site.
- 10.3.6 Leak Checks - The full procedure is found in Section 5.6 of REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015. The procedure in the current manual must be followed precisely.

CAUTION: PRIOR TO MAKING ANY ADJUSTMENTS TO THE FLOW SYSTEM THE OPERATOR MUST DOCUMENT THE “AS FOUND” CONDITIONS. THIS DOCUMENTATION SHOWS THAT THE FLOWRATE WAS WITHIN ACCEPTABLE LIMITS BACK TO THE MOST RECENT SUCCESSFUL FLOWRATE AUDIT OR CHECK. AFTER ANY ADJUSTMENTS ARE MADE THE OPERATOR MUST DOCUMENT THE “AS LEFT” CONDITIONS.

The general project specific procedure follows.

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1. Place the Xact in standby mode.
2. Move the tape to a clean spot.
3. Install the ball valve on the inlet down tube and close the valve.
4. Select Leak 2 from the Test menu on the Xact controller.
5. Allow the system to draw a vacuum and close the pump ball valve.
6. Immediately press “pump off” and press reset.
7. Wait 90 seconds and record the rate in the logbook and on the Xact QC check sheet. (should be less than 150mmHg/min).
8. Change the 2/3 Way valve to ON.
9. Slowly open valve on inlet tube. After the pressure is relieved close the valve.
10. Open valve on pump.
11. Press pump on and follow steps 5-7 for the valve ON position.
12. Slowly open valve on inlet tube. After the pressure is relieved close the valve.
13. Open valve on pump.
14. Evaluate the results and determine if additional action is needed.

10.3.7 Temperature and Pressure Sensor Calibration Test - The full procedure is found in Section 5.7 of REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015. The procedure in the current manual must be followed precisely.

The general project specific procedure follows.

1. Equilibrate the certified flow/pressure/temperature standard. This is accomplished by setting the flow standard outside in the shade for approximately 20 minutes prior to taking readings.
2. Put the Xact in Standby mode.
3. Remove the PM inlet and install the certified flow/pressure/temperature standard.
4. In the Test Screen press FLOW CAL.

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5. Record the stabilized “AS FOUND” readings. Be sure the temperature probe is placed next to the Xact temperature probe when this reading is taken.
6. Compare the readings with the MQO table and determine if action is necessary.

10.3.8 Flow Calibration Test- The full procedure is found in Section 5.8 of REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015. The procedure in the current manual must be followed precisely. Typically, this test is completed immediately following the Temperature and Pressure Sensor Calibration Test.

The general project specific procedure follows.

1. After the Temperature and Pressure Sensor Calibration Test move the cursor on the Xact controller to 15.0 LPM.
2. Record the stabilized “AS FOUND” readings in the logbook.
3. Compare the readings with the MQO table and determine if action is necessary.
4. Repeat steps 1-3 for the 16.7 and 18.4 LPM settings. Also, record the 16.7 “AS FOUND” readings in the QC check sheet.

10.3.9 Flow Calibration - The full procedure is found in Section 5.9 of REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015. The procedure in the current manual must be followed precisely. Typically, this test is completed upon installation, if the action limit in the MQO table is breached or every three months.

The general project specific procedure follows.

1. Place the Xact in standby mode.
2. Move the tape to a clean spot.
3. Conduct a Temperature and Pressure Sensor Calibration Test and a Flow Calibration Test.
4. Record all “AS FOUND” readings in the logbook and QC check sheet.

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5. Calibrate the Pressure and the Temperature channels. Ensure that all readings are stable and properly obtained.
 6. Input the actual flows in the Xact controller at each of the 3 set points (15.0, 16.7 and 18.4 LPM). Ensure that each flow is run for long enough time to obtain a stable reading (approximately 1-5 minutes).
 7. Once the pressure, temperature, and flows have been input press the CAL button. This will calibrate the flow system.
 8. Conduct a Temperature and Pressure Sensor Calibration Test and a Flow Calibration Test.
 9. Record all “AS LEFT” readings in the logbook and QC check sheet.
 10. Remove the flow standard device from the inlet and replace the sampling head.
- 10.3.10 Examine tubing, enclosure, and components for particle build-up, rust or damage. Replace and clean parts as needed. The operator must be sufficiently familiar with the Xact system to complete this process effectively. The operator must document this in the logbook and the site check sheet.
1. Remove and clean the sampling head.
 2. Remove and clean the downtube.
 3. Inspect the instrument cabinet, shelter and Xact modules for dust and clean.
 4. Inspect all flow components for damage or wear.
- 10.3.11 Complete Site Check Sheet – The site check sheet is in Appendix F. Be sure to read each statement and circle yes or no. Use the comments section or blank space for additional information. The site check sheet should be completed during each site visit.
- 10.3.12 Update the QA Tracking spreadsheets for nightly checks and blanks as needed – Tracking spreadsheets should be developed and updated to show variability over time of the nightly checks and blank checks. The operator and data analyst should be aware of any action limits and utilize the charts to determine if drift of a check is approaching an action limit or has failed to meet

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specified criteria. When these limits are reached action should be taken as soon as possible.

- 10.3.13 Tape Replacement Procedure – The full procedure is found in Section 4.4 of REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015. The procedure in the current manual must be followed precisely.

The general project specific procedure follows.

1. **CAUTION: IF OPERATOR IS OPENING FRONT BOX you must wait for X-ray voltage and current to ramp down (see XRF_Control) and red light to turn off on XRF module. After the light is off the operator may then remove the X-ray key and unlock the door using the door key. THE DOOR CANNOT BE OPENED IF THE X-RAY IS ENERGIZED AND THE RED LIGHT IS ON. NEVER ATTEMPT TO DEFEAT THE TWO KEY SAFETY SYSTEM (SEE SECTION 5.0 SAFETY AND THE OPERATORS MANUAL FOR FURTHER SAFETY PRECAUTIONS).**
2. Approximate tape replacement frequency is as follows:

Sampling Time (Minutes)	Tape Changed Every
15	6 days
60	25 days
240	3 months

3. Put Xact in Standby mode.
4. Press TEST from the main screen and then press TAPE.
5. Press NOZ DN and wait for the State to read Nozzle down.
6. Open the sampling cabinet and remove the feed reel and uptake reel nuts.
7. Using a pair of sharp scissors cut the tape just above the feed reel.
8. Remove tape from uptake reel and wind on remaining tape. Place this in plastic bag. It is optional for the operator to label and store the used tape.
9. Remove feed reel and place on uptake side. Place new tape on feed reel.
10. Using small piece of tape attach the new tape to the unused portion of the old tape and manually advance 1-2 full windings.

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11. Replace feed reel and uptake reel nuts.
12. From the front panel press MOVE to watch the tape advance. Ensure that the tape is advancing properly. Repeat this 2-3 times.
13. Close front panel, lock, replace X-ray key and turn key to the on position.
14. From the operate screen highlight the current mode and press EDIT. Cursor to run to put the Xact in run mode (wait for pump to start).

11.0 DATA VALIDATION PROCESS AND RECORDS MANAGEMENT

- 11.1 Data shall be presented to the QA Coordinator as a complete set including quality control charts, log book entries, and any other requested information or forms. Under no circumstances will a data set include missing intervals of data. Data will either be “valid”, “invalid” or “qualified” according to the data validation template. The project manager will compile the final data set. The site operator may compile a Data Record (see Appendix I) and present it to the project manager to assist. The Data Record shall summarize all field activities. The project manager will compile the data set in a manner that clearly describes the invalid, valid and qualified hours and the reason the hours were invalidated qualified. Data will be qualified and/or invalidated according to the Data Validation Table. Under no circumstances will data be considered valid when the criteria listed in the Data Validation Table have not been reviewed and documented. A memorandum will accompany the data set requesting official review and approval of the data set by the QA Coordinator. Once the data set is approved by the QA Coordinator the data are considered valid. The QA Coordinator will submit a memorandum stating that they believe the data are correctly reported according to the Quality Assurance Project Plan. The QA Coordinator will never be involved in the actual data collection process. See Appendix E for an example data submittal/approval.
- 11.2 Final data and supporting documentation will be stored in the Xact SharePoint site specific folder.
- 11.3 Raw data are stored in 2 locations onsite. The data are stored in the Xact 625 internal data logging system and an ESC 8872 Data Controller system.
- 11.4 Data are to be downloaded from the ESC 8872 for all normal operations. The data can be downloaded from the Xact 625 using the Xact Terminal program in cases where the ESC 8872 has malfunctioned or is otherwise not available. The manual data download

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procedure using the Xact Terminal and the data download procedure using the ESC 8872 are described below. The 8872 is the primary data storage device. The Xact Terminal program will typically be used for downloading the Xact data for the nightly check data.

11.4.1 Manual Data Download Using the ESC 8872

1. Open the Reports tab in the 8872 software.
2. Select the parameters and dates for needed data set.
3. Click on create report.

11.4.2 Manual Data Download Procedure Using Xact Terminal - The full procedure is found in Section 4.9.3 of REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015. The procedure in the current manual must be followed precisely.

CAUTION: DO NOT use Xact Terminal at the beginning or ending of an analysis cycle. The safest time is at half past the hour. During the beginning or ending of an analysis cycle, the Sample Controller bus is very busy and extra interrupts may hang the bus cycle mechanism. If this happens, the system places itself in standby and the operator will be required to reboot the system. This will result in data lose and must avoided.

1. Open Xact Terminal on the computer.
2. Click File and then Open Log File.
3. Create a site-specific folder on the desktop and name the folder after the current site name. Save all data from this site to the folder.
4. Name the file according to the date range of the data download (for example YYYYMMDD to YYYYMMDD). Click open.
5. Enter the number of **HOURS** you would like to download in the box PR3. For example, if 24 is entered in PR3 then the last 24 hours of data will be downloaded. Click Print Recorder (PR3) and the data will begin to be recorded.
6. Once the data stops printing click File and then Close Log File.
7. Find and open the txt file to ensure that it was saved properly.
8. Close Xact Terminal.

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- 11.5 All data sheets, tracking tables, and log books must be filled out completely and accurately. If the operator makes an error in any handwritten notation on the calibration sheet or field logbook the operator should make one line through the error, initial and date the line and then notate the correction.

12.0 QUALITY CONTROL & QUALITY ASSURANCE

- 12.1 Performance of the metals monitor will be assessed by following all vendor recommendations, specifications and procedures. The following table summarizes the MQO's. All MQO activities are described and standardized in this SOP and the instrument manual and must be used when validating data and when assessing if actions are required by the operator if an action limit is breached.

Table 3: MEASUREMENT QUALITY OBJECTIVE TABLE

CRITERIA	FREQUENCY	ACCEPTABLE RANGE AND ACTION LIMITS	REFERENCE
XRF Calibration	Upon Failure of XRF Independent Calibration Check, X-ray tube change or other major repairs.	Per CES	CONTACT CES
QA Energy Calibration	Automated daily, after initial installation and before Full XRF Calibration.	Pass/Fail according to Xact firmware ACTION LIMIT: Peak Height $\pm 7,000$ Retries ± 2 ACTION: Contact CES	REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015, Section 5.4 Xact SOP Section 10.3.2
QA Upscale Test (internal upscale rod and Pd)	Daily – Automated or Manual	$\pm 10\%$ from the most recent calibration reference point. ACTION LIMIT: 5% ACTION: Contact CES	REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015, Section 5.5 Xact SOP Section 10.3.3
Manual QA Blank Test	After initial installation, before	Determine if blank levels are increasing	REV P4 Xact 625 Operation and

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CRITERIA	FREQUENCY	ACCEPTABLE RANGE AND ACTION LIMITS	REFERENCE
	Full XRF Calibration and monthly	over time. ACTION LIMIT: 14 ng for 60-minute sampling time ACTION: Repeat the blank test. Contact CES. Clean XRF chamber.	Maintenance Manual 5/29/2015 Section 5.3 (13.3 ng is the highest 60-minute MDL in Table 10.) Xact SOP Section 10.3.4
XRF Calibration Test (independent thin film standards)	Quarterly or after initial installation	Average of all comparisons (at least one in each energy condition) $\pm 10\%$ of known metals standard ACTION LIMIT: 5% ACTION: Contact CES	REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015, Section 5.10.1 Xact SOP Section 10.3.5
Leak Checks	Prior to Flow Calibration Test or Flow Calibration	Leak Test 2 (2/3 ON and 2/3 OFF) Vacuum Lose Rate < 150 mmHg/min ACTION LIMIT: 100 mmHg/min ACTION: Clean nozzle, clean down tube connection, check tension on nozzle. Redo test.	REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015, Section 5.6 Xact SOP Section 10.3.6
Temperature and Pressure Sensor Calibration Test	Monthly	Temperature = ± 2.0 degrees C Pressure = ± 10 mm Hg If either check fails then complete a full	Section 5.7 of REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015, Section 5.7 Xact SOP Section 10.3.7

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CRITERIA	FREQUENCY	ACCEPTABLE RANGE AND ACTION LIMITS	REFERENCE
		<p>calibration. NOTE: An as found flow test must be conducted and documented PRIOR to any adjustment.</p> <p>Any adjustment made to the temperature or pressure will require a flow calibration be completed.</p> <p>ACTION LIMIT: Temperature = ± 1.5 degrees C Pressure = 7 mm Hg ACTION: Conduct calibration</p>	
Flow Calibration Test	Monthly	<p>TSP sampling head: $\pm 10\%$ of actual flow versus Xact reading</p> <p>PM10 sampling head: $< + 4.1\%$ of transfer standard $< + 5.1\%$ of flow rate design value</p> <p>If check fails then complete a full calibration. NOTE: An as found flow test must be conducted and documented PRIOR to any adjustment.</p> <p>ACTION LIMIT: TSP = 7.5%</p>	<p>REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015, Section 5.9</p> <p>USEPA QA Handbook Volume II Validation Template (for PM10 Low Volume)</p> <p>Xact SOP Section 10.3.9</p>

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CRITERIA	FREQUENCY	ACCEPTABLE RANGE AND ACTION LIMITS	REFERENCE
		PM10 =75% of limit ACTION: Complete calibration of temperature, pressure and flowrate.	
Flow Calibration	Upon installation, quarterly or upon failure of test	TSP sampling head: $\pm 5\%$ of actual flow versus Xact reading PM10 sampling head: $< + 4.1\%$ of transfer standard $< + 5.1\%$ of flow rate design value NOTE: An as found flow test must be conducted and documented PRIOR to any adjustment.	REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015, Section 5.9 USEPA QA Handbook Volume II Validation Template (for PM10 Low Volume) Xact SOP Section 10.3.9
Examine tubing, enclosure, and components for particle build-up, rust or damage.	Following installation and Monthly	Examine downtube tubing, enclosure, and for visible problem. ACTION LIMIT: Observe visible problem ACTION: Replace or clean components. Examine more often.	REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015, Section 3.0 Xact SOP 10.3.9
Clock Check for Xact controller, computer and ESC 8872 data logger	After initial set up	Within 5 minutes of actual time read from a cellular phone or www.time.gov	REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015, Section 4.5.1

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CRITERIA	FREQUENCY	ACCEPTABLE RANGE AND ACTION LIMITS	REFERENCE
		ACTION LIMIT: ±3 minutes ACTION: Reset times	
Independent audits of Leak Check, Temperature, Pressure and Flow	Quarterly or at least 1 per sampling project	All criteria and action limits are the same as above.	Same as above.

12.2 Data must be reported according to the following Data Validation Table. The standard list of AQS data qualifiers will be used when MQO's are not met. The list of AQS data qualifiers are included as Appendix H.

Table 4: Data Validation Table

Data Column or MQO	Description	Acceptable range	Action if Acceptable Range NOT Met
AT (C)	Ambient temperature	Within local extremes for time of year.	Determine when sensor failed and invalidate all data collected during time when sensor was found to be malfunctioning.
BP (mmHg)	Barometric pressure	Within local extremes, ~700-800 mmHg	Determine when sensor failed and invalidate all data collected during time when sensor was found to be malfunctioning.
TAPE (mmHg)	Tape pressure	Must be lower than barometric pressure	Invalidate all data back to when tape pressure exceeded barometric pressure.

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Data Column or MQO	Description	Acceptable range	Action if Acceptable Range NOT Met
SAMPLE (%)	Sample relative humidity	<75%	Invalidate all data when criteria not met.
FLOW ACT (lpm)	Actual flow (local conditions)	Hourly values: TSP sampling head: $\pm 10\%$ of set point (e.g. 16.67) PM10 sampling head: < + 4.1% of transfer standard < + 5.1% of flow rate design value (16.67 lpm)	TSP sampling head: Qualify all data when criteria not met. PM10 sampling head: Invalidate all data when criteria not met.
QA FLOW (lpm)	Daily automated flow check (local conditions)	Hourly values: TSP sampling head: $\pm 10\%$ of set point (e.g. 16.67) PM10 sampling head: < + 4.1% of transfer standard < + 5.1% of flow rate design value (16.67 lpm)	Qualify all data when criteria not met.
VOLUME (m3)	Volume of sample passing through filter spot	>0.90 for 1-hr sample; >0.45 for ½-hr. (the sample reported at 01:00 is collected during the daily QA checks and will therefore be a 30-minute sample)	Qualify all data when criteria not met.
TUBE TEMP(C)	Sample tube temperature	<40C	Qualify all data back to most recent reading within limits.
XRF ENCLS(C)	Enclosure temperature	<40C	Qualify all data back to most recent reading within limits.

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Data Column or MQO	Description	Acceptable range	Action if Acceptable Range NOT Met
Chromium (Cr), Cadmium (Cd), Lead (Pb)	QA Upscale Test for Cr, Pb, Cd. (automated or manual)	Daily reported at 0:30. Upscale Cr, Pb, Cd should not change by more than 10% from the most recent calibration reference point.	Invalidate all data when criteria not met. Invalidate data back to most recent successful check.
Palladium (Pd)	Internal Pd Check (automated or manual)	Reported Hourly. Pd should not change by more than 10% from the most recent calibration reference point.	Invalidate all data when criteria not met. Invalidate data back to most recent successful check.
XRF Calibration Test (independent thin film standards)	Quarterly check of independent thin film metals standards (at least one in each energy condition) versus XRF response	Average of all comparisons (at least one in each energy condition) $\pm 10\%$ of known metals standard	Data is Qualified back to most recent successful Independent Calibration Check
QA Energy Calibration	Automated or Manual Energy Check	Pass/Fail according to Xact firmware	Contact CES for guidance
QA Blank Test	Manual blank test	Determine if blank levels are increasing over time and if the level of the blank test could impact Data Quality Objectives.	Qualify all data back to most recent passing test.
Leak Checks	Manual leak check	LEAK CHECK 2 (2/3 ON and 2/3 OFF) Vacuum Lose Rate < 150 mmHg/min	2/3 OFF: Qualify all data back to most recent successful leak check. 2/3 ON: Invalidate all nightly QC checks back to most recent successful 2/3 ON leak

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Data Column or MQO	Description	Acceptable range	Action if Acceptable Range NOT Met
			check.
Temperature Calibration Test	Temperature sensor comparison versus standard device	± 2.0 degrees C Difference	Qualify all data back to most recent successful temperature check
Barometric Pressure Calibration Test	Barometric pressure sensor comparison versus standard device	± 10 mm Hg Difference	Qualify all data back to most recent successful barometric pressure check
Flow Calibration Test	Sample flow rate comparison versus standard device	TSP sampling head: $\pm 10\%$ of 16.67 PM10 sampling head: < + 4.1% of transfer standard < + 5.1% of flow rate design value (16.67 lpm)	Qualify all data back to most recent successful flow check or calibration
Clock Check/Calibration	Clock comparison versus cell phone device or www.time.gov	Within 5 minutes of actual time.	Qualify all data back to most recent successful clock check.
Independent Leak Check Audit, Temperature Audit, Barometric Pressure Audit, Flow Audit	Independent audits	All criteria same as checks above.	Qualify all data back to most recent successful leak check

12.3 All QA/QC procedures listed in this SOP shall be properly documented as described below.

Procedure/Task	Form of Documentation
XRF Calibration	1. Logbook notation 2. Stored in station computer 3. Xact site check sheet
QA Energy Calibration (perform before an XRF calibration)	1. Logbook notation for manual 2. Xact computer

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Procedure/Task	Form of Documentation
	3. SharePoint under site file folder 4. Xact site check sheet
QA Upscale Test (internal upscale rod and Pd)	1. Manual check will be notated in logbook 2. Automated checks are recorded with time stamp 0:30 daily in regular raw data set. 3. Control Chart
Manual QA Blank Test	1. Logbook notation 2. Stored in station computer 3. Xact site check sheet 4. Control Chart
XRF Calibration Test (independent thin film standards)	1. Logbook notation 2. Stored in station computer 3. Control chart 4. Xact site check sheet
Leak Test	1. Logbook notation 2. Xact Quality Control Check Table 3. Xact site check sheet
Temperature and Pressure Sensor Calibration Test	1. Logbook notation 2. Xact Quality Control Check Table 3. Xact site check sheet
Flow Calibration Test	1. Logbook notation 2. Xact Quality Control Check Table 3. Xact site check sheet
Flow Calibration	1. Logbook notation 2. Xact site check sheet
Examine tubing, enclosure, and components for particle build-up, rust or damage. Replace and clean parts as needed.	1. Logbook notation 2. Xact site check sheet
Tape Change	1. Logbook notation 2. Xact site check sheet
Time Check/Calibration	1. Logbook notation 2. Xact site check sheet
Independent audits of Leak Check, Temperature, Pressure and Flow	1. Logbook notation 2. Xact site check sheet

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13.0 REFERENCES

13.1 REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015

13.2 USEPA QA Handbook Volume II

14.0 ATTACHMENTS

APPENDIX LISTING

APPENDIX A -	REV P4 Xact 625 Operation and Maintenance Manual 5/29/2015
APPENDIX B -	Suggested Minimum Xact Station Logbook Entries
APPENDIX C -	Xact Quality Control Check Table
APPENDIX D -	Xact Trailer Drawings
APPENDIX E -	Example Data Set Submission
APPENDIX F -	Site Check Sheet
APPENDIX G -	Metals Standards Analysis Report and NIST SRM 1832 and 1833 Certificate of Traceability
APPENDIX H -	List of AQS Data Qualifiers
APPENDIX I -	Data Record Example